



# Manufacturing & Prototyping

## Antimicrobial-Coated Granules for Disinfecting Water

*Lyndon B. Johnson Space Center, Houston, Texas*

Methods of preparing antimicrobial-coated granules for disinfecting flowing potable water have been developed. Like the methods reported in the immediately preceding article, these methods involve chemical preparation of substrate surfaces (in this case, the surfaces of granules) to enable attachment of antimicrobial molecules to the surfaces via covalent bonds. A variety of granular materials have been coated with a vari-

ety of antimicrobial agents that include antibiotics, bacteriocins, enzymes, bactericides, and fungicides. When employed in packed beds in flowing water, these antimicrobial-coated granules have been proven effective against gram-positive bacteria, gram-negative bacteria, fungi, and viruses. Composite beds, consisting of multiple layers containing different granular antimicrobial media, have proven particularly effec-

tive against a broad spectrum of microorganisms. These media have also proven effective in enhancing or potentiating the biocidal effects of in-line iodinated resins and of very low levels of dissolved elemental iodine.

*This work was done by James R. Akse, John T. Holtsnider, and Helen Klietk of Umpqua Research Co. for Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-23468-1*

## Range 7 Scanner Integration With PaR Robot Scanning System

**Models of complex objects can be developed even if the objects are large and featureless.**

*John F. Kennedy Space Center, Florida*

An interface bracket and coordinate transformation matrices were designed to allow the Range 7 scanner to be mounted on the PaR Robot detector arm for scanning the heat shield or other object placed in the test cell. A process was designed for using Rapid Form XOR to stitch data from multiple scans together to provide an accurate 3D model of the object scanned.

An accurate model was required for the design and verification of an existing heat shield. The large physical size and complex shape of the heat shield does not allow for direct measurement of certain features in relation to other features. Any imaging devices capable of imaging the entire heat shield in its entirety suffers a reduced resolution and cannot image sections that are blocked from view. Prior methods involved tools such as commercial measurement arms, tak-

ing images with cameras, then performing manual measurements. These prior methods were tedious and could not provide a 3D model of the object being scanned, and were typically limited to a few tens of measurement points at prominent locations.

Integration of the scanner with the robot allows for large complex objects to be scanned at high resolution, and for 3D Computer Aided Design (CAD) models to be generated for verification of items to the original design, and to generate models of previously undocumented items.

The main components are the mounting bracket for the scanner to the robot and the coordinate transformation matrices used for stitching the scanner data into a 3D model. The steps involve mounting the interface bracket to the robot's detector arm, mounting the scan-

ner to the bracket, and then scanning sections of the object and recording the location of the tool tip (in this case the center of the scanner's focal point).

A novel feature is the ability to stitch images together by coordinates instead of requiring each scan data set to have overlapping identifiable features. This setup allows models of complex objects to be developed even if the object is large and featureless, or has sections that don't have visibility to other parts of the object for use as a reference. In addition, millions of points can be used for creation of an accurate model [i.e. within 0.03 in. ( $\approx 0.8$  mm) over a span of 250 in. ( $\approx 635$  mm)].

*This work was done by Bradley Burns, Jeffrey Carlson, Mark Minich, and Jason Schuler of Kennedy Space Center. Further information is contained in a TSP (see page 1). KSC-13489/95*

## Methods of Antimicrobial Coating of Diverse Materials

*Lyndon B. Johnson Space Center, Houston, Texas*

Methods of coating diverse substrate materials with antimicrobial agents have been developed. Originally intended to reduce health risks to astronauts posed by pathogenic microorgan-

isms that can grow on surfaces in spacecraft, these methods could also be used on Earth — for example, to ensure sterility of surgical inserts and other medical equipment. The methods in-

volve, generally, chemical preparation of substrate surfaces to enable attachment of antimicrobial molecules to the substrate surfaces via covalent bonds. Substrate materials that have been

treated successfully include aluminum, glass, a corrosion-resistant nickel alloy, stainless steel, titanium, and poly(tetrafluoroethylene). Antimicrobial agents that have been successfully immobilized include antibiotics, enzymes, bacteriocins, bactericides, and fungicides.

A variety of linkage chemistries were employed. Activity of antimicrobial coatings against gram-positive bacteria, gram-negative bacteria, and fungi was demonstrated. Results of investigations indicate that the most suitable combination of antimicrobial agent, sub-

strate, and coating method depends upon the intended application.

*This work was done by James R. Akse, John T. Holtsnider, and Helen Klietk of Umpqua Research Co. for Johnson Space Center. For further information, contact the Johnson Commercial Technology Office at (281) 483-3809. MSC-23467-1*

## High-Operating-Temperature Barrier Infrared Detector With Tailorable Cutoff Wavelength

**Novel materials allow the detector to operate at higher temperatures.**

*NASA's Jet Propulsion Laboratory, Pasadena, California*

A mid-wavelength infrared (MWIR) barrier photodetector is capable of operating at higher temperature than the prevailing MWIR detectors based on InSb. The standard high-operating-temperature barrier infrared detector (HOT-BIRD) is made with an InAsSb infrared absorber that is lattice-matched to a GaSb substrate, and has a cutoff wavelength of approximately 4 microns. To increase the versatility and utility of the HOT-BIRD, it is implemented with IR absorber materials with customizable cutoff wavelengths.

The HOT-BIRD can be built with the quaternary alloy GaInAsSb as the absorber, GaAlSbAs as the barrier, on a lattice-matching GaSb substrate. The cutoff wavelength of the GaInAsSb can be tailored by adjusting the alloy composition. To build a HOT-BIRD requires a matching pair of absorber and barrier materials with the following properties: (1) their valence band edges must be approximately the same to allow unimpeded hole flow, while their conduction

band edges should have a large difference to form an electron barrier; and (2) the absorber and the barrier must be respectively lattice-matched and closely lattice-matched to the substrate to ensure high material quality and low defect density.

To make a HOT-BIRD with cutoff wavelength shorter than 4 microns, a GaInAsSb quaternary alloy was used as the absorber, and a matching GaAlSbAs quaternary alloy as the barrier. By changing the alloy composition, the band gap of the quaternary alloy absorber can be continuously adjusted with cutoff wavelength ranging from 4 microns down to the short wavelength infrared (SWIR). By carefully choosing the alloy composition of the barrier, a HOT-BIRD structure can be formed. With this method, a HOT-BIRD can be made with continuously tailorable cutoff wavelengths from 4 microns down to the SWIR.

The HOT-BIRD detector technology is suitable for making very-large-format

MWIR/SWIR focal plane arrays that can be operated by passive cooling from low Earth orbit. High-operating-temperature infrared with reduced cooling requirement would benefit space missions in reduction of size, weight, and power, and an increase in mission lifetime.

*This work was done by David Z. Ting, Cory J. Hill, Alexander Soibel, Sumith V. Bandara, and Sarath D. Gunapala of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact [iaoffice@jpl.nasa.gov](mailto:iaoffice@jpl.nasa.gov).*

*In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:*

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